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March 22, 1999

# **AEROSPACE MEDICINE AND BIOLOGY**

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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	Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.	
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# Typical Report Citation and Abstract

① 19970001126 NASA Langley Research Center, Hampton, VA USA  
② Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes  
③ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;  
④ Mar 1996; 130p. In English  
⑤ Contract(s)/Grant(s): RTOP 505-68-70-04  
⑥ Report No.: NASA TM-4663; NAS 1.15-4663; L-17418; No Copyright. Avail: CASI; A07, Hardcopy; A02, Microfiche  
⑦ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortices on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.  
⑧ Author  
⑨ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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# AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 487)

MARCH 22, 1999

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## LIFE SCIENCES (GENERAL)

1999019291 Queens Univ., Advisory Research Committee, Kingston, Ontario Canada

Modeling the C Economy of Anabaena Flos-Aquae

Turpin, David H., Queens Univ., Canada; Layzell, David B., Queens Univ., Canada; Ulrich, Ivor P., Queens Univ., Canada; Plant Physiology, 1985, ISSN 0032-0889, Volume 78, pp. 746-752. In English. Copyright: Avail: Issuing Activity, Hardcopy, Microfiche

Steady state cultures of *Anabaena flos-aquae* were established over a wide range of phosphate-limited growth rates while N was supplied as either NH<sub>3</sub>, NO<sub>3</sub>-i, or N<sub>2</sub> gas. At growth rates greater than 0.03 per hour, rates of gross and net carbon fixation were similar on all N sources. However, at lower growth rates (less than 0.03 per hour) in the NO<sub>3</sub>-i and N<sub>2</sub> cultures, gross photosynthesis greatly exceeded net photosynthesis. The increase in photosynthetic O<sub>2</sub> evolution with growth rate was greatest when N requirements were met by NO<sub>3</sub>-i and least when met by NH<sub>3</sub>. These results were combined with previously reported measurements of cellular chemical composition, N assimilation, and acetylene reduction to construct empirical models of carbon and energy flow for cultures grown at 30, 60, and 100% of their maximal growth rate on all N sources. The models suggested that over this growth range, 89 to 100% of photodriven electrons were allocated to biomass production in the NH<sub>3</sub> cells, whereas only 49 to 74% and 54 to 90% were partitioned to biomass in the NO<sub>3</sub>-i and N<sub>2</sub>-grown cells, respectively. The models were used to estimate the relative contribution of active, maintenance, and establishment costs associated with NO<sub>3</sub>-i and N<sub>2</sub> assimilation over the entire range of growth rates. The models showed that the relative contribution of the component costs of N assimilation were growth rate dependent. At higher growth rates, the major costs for NO<sub>3</sub>-i assimilation were the active costs, while in N<sub>2</sub>-fixing cultures the major energetic requirements were those associated with heterocyst establishment and maintenance. It was concluded that compared with NO<sub>3</sub>-i assimilation, N<sub>2</sub> fixation was energetically unfavorable due to the costs of heterocyst establishment and maintenance, rather than the active costs of N<sub>2</sub> assimilation.

Author

Nitrogen Compounds; Chemical Composition; Costs; *Anabaena*; Estimating; Nitrogen; Photosynthesis; Phosphates; Biochemistry

1999019297 Cornell Univ., Dept. of Mathematics, Ithaca, NY USA

Spatial Aspects of Interspecific Competition

Durrett, Rick, Cornell Univ., USA; Levin, Simon, Princeton Univ., USA; Theoretical Population Biology, Feb. 1998, ISSN 0304-3899, Volume 53, No. 1, pp. 39-43. In English  
Contract(s)/Grant(s): N00014-92-J-1527, NAGS-6422, NSF DMS-93-01070; NSF BIR-94-23339, NAGs-4688; Copyright: Avail: Issuing Activity, Hardcopy, Microfiche

Using several variants of a stochastic spatial model introduced by Silvertown et al., we investigate the effect of spatial distribution of individuals on the outcome of competition. First, we prove rigorously that if one species has a competitive advantage over each of the others, then eventually it takes over all the sites in the system. Second, we examine tradeoffs between competition and dispersal distance in a two-species system. Third, we consider a cyclic competitive relationship between three types. In this case, a nonspatial treatment leads to densities that follow neutrally stable cycles or even unstable spiral solutions, while a spatial model yields a stationary distribution with an interesting spatial structure.

Author

Spatial Distribution; Competition; Stability; Mathematical Models; Stochastic Processes

[109900]9801: Colorado Univ., BioServe Space Technologies, Boulder, CO USA

A Review of Plant Experiments Supported by the Astro/Plant Generic Bioprocessing Apparatus on MSL-1

Heyenga, A. G., Colorado Univ., USA; Stodieck, Louis S., Colorado Univ., USA; Hochm, A., Colorado Univ., USA; Microgravity Science Laboratory (MSL-1); November 1998, pp. 2-7, In English; See also 10990019800; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The utilization of plant-based materials in modern human society is extensive and of considerable commercial value including the production of food, pharmaceutical, lumber, and paper products. The advent of space flight research and the means to cultivate plants in the near absence of gravity have provided a unique opportunity to expand our understanding of plant physiology, metabolism, and genetics and to develop new approaches to further utilize this resource. An area of specific commercial interest encompasses the prospect that microgravity may be used to alter and help elucidate the control mechanisms of certain plant metabolic pathways enabling the further genetic engineering and cultivation of plants with desired traits on Earth. Particular attention is being directed towards the study of the cell structural compound lignin. A potential decrease in the production of such a compound could result in a corresponding increase in the production of metabolically related compounds including lignans and neo-lignans that are of significant medicinal value. An alteration in metabolic flux may equally extend to an enhancement in the production of compounds arising from the valuable alkaloid and terpene pathways. Additional areas in which the absence of gravity may influence plant metabolism include the production and distribution of plant growth control factors such as auxins and in the production of ligand molecules involved in the recognition system of plant symbiotic associations with microorganisms. The latter process is of significant value to agriculture in such areas as nitrogen fixation. The implementation of the MSL-1 plant study conducted on the Shuttle mission STS-94 was directed towards establishing an initial experimental baseline in plant response and applying investigative techniques that include the use of radioisotopes and molecular markers. A number of plant species were cultivated for 16 days in the Astro/Plant Generic Bioprocessing Apparatus (Astro/PGBA) under defined environmental conditions. The principle areas of investigation involved an examination of (a) lignin and vinca alkaloid metabolism, (b) the response of an auxin inducible GH3 gene, and (c) the interactive association of wheat with Rhizobium bacteria.

Author

*Radioactive Isotopes; Plants (Botany); Nitrogenation; Pharmacology; Genetic Engineering; Vegetation Growth; Microgravity; Genetics*

[109900]9804: Toronto Univ., Dept. of Geology, Ontario Canada

Bacterial Mineral Precipitation and the Making of Microfossils

Ferris, F. G., Toronto Univ., Canada; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?; 1998, pp. 12-13, In English; See also 10990020835; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

An important prerequisite for the precipitation of minerals from aqueous solutions, even where bacteria are involved, is that a moderate degree of oversaturation must be achieved. This requirement is imposed thermodynamically by an activation energy barrier that constrains the spontaneous formation of insoluble precipitates from solution. Bacteria intervene in mineral precipitation reactions in two ways, either directly as catalysts of aqueous geochemical reactions or indirectly as chemically reactive solids. In the first case, bacterial metabolic activity is often significant and can trigger changes in solution chemistry that lead to oversaturation (e.g., through the production of reactive ligands like sulfide). This alone can induce mineral formation by lowering the activation energy barrier for homogenous (precipitation in solution) and heterogeneous (surface precipitation on foreign solids) nucleation reactions. The second case relates to the presence of reactive amphoteric sites on bacterial cells that facilitate sorption of dissolved mineral-forming elements, and foster heterogeneous surface precipitation reactions. Thus, minerals precipitated directly from solution as a result of bacterial metabolic activity can form on the inside, outside, or even some distance away from cells. Indirect chemical precipitation as a consequence of changing geochemical conditions is also possible and is accompanied by passive epicellular nucleation and crystal growth on the outside of living or dead bacterial cells, this is the most likely pathway leading toward preservation of structurally intact microfossils. In natural systems, however, direct and indirect bacterial mineral precipitation reactions may occur at the same time and are difficult to recognize as entirely separate processes. When bacteria are metabolically involved in mineral formation, biogenicity can sometimes be inferred from chemical (e.g., stable isotope) or mineralogical (e.g., magnetite produced by magnetotactic bacteria) data. On the other hand, microscopic techniques are useful in the assessment of cell-surface-mediated mineral precipitation providing that diligence is exercised to unequivocally establish the composite nature (i.e., mineralogical and bacterial) of the specimen.

Author

*Bacteria; Chemical Reactions; Geochemistry; Microorganisms; Mineralogy; Fossils; Palaeobiology*

19990020847: Granada Univ., Facultad de Ciencias, Spain

Biominetic Inst Abiotic Carbonates: New Geochemical Markers for Primitive Environments

Garcia-Ruiz, J. M., Granada Univ., Spain; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 16-17; In English; See also 19990020835; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The unambiguous detection of ancient life is a crucial necessity in assessing the timing of life on Earth. Today, the strategy to reveal features of past life forms is also of utmost importance in seeking out living beings on other planets. Among other very few biomarkers used today (stromatolite structures, antifreeze minerals, biological degradation compounds, and isotopic analysis), morphological recognition of living forms still plays a critical role in Precambrian micropaleontological studies. The underlying principle supporting life detection using morphological and textural tools derived from the old idea that inorganic precipitates are unable to produce neither shapes displaying certain symmetry groups nor certain bizarre textural arrangements. In this frame of mind, there is a substantial morphological difference between the inanimate and the animate worlds: it was thought that certain complex shapes with noncrystallographic symmetry were characteristic of life and would be impossible to obtain by inorganic precipitation. The most recent and conspicuous application of this "law" is the fossil-like microstructures found in ALH 84001.

Author

*Exobiology, Carbonates, SNC Meteorites, Extraterrestrial Life, Biogeochemistry*

19990020856: Harvard Univ., Botanical Museum, Cambridge, MA USA

The Signature of Life: Is it Legible?

Knoll, A. H., Harvard Univ., USA; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, 2p; In English; See also 19990020835; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

Everyday experience suggests that the gulf between biology and the physical world is conspicuous. This impression arises, however, because the biology most familiar to us is largely that of organisms found on distal branches of the tree of life. The difficulty in distinguishing biogenic from abiogenic forms lies at the other end of the tree: life arose as the self-perpetuating product of physical processes, and it is likely that the characteristics of Earth's earliest organisms - their size, shape, molecular composition, and catalytic properties - bore a close resemblance to products of the physical processes that gave rise to life.

Author

*Chemical Composition, Organisms, Mars Environment, Mars Surface, Extraterrestrial Life, Microorganisms*

19990020857: Institute of Space Research, Moscow, USSR

Martian Biogenic Activity: Looking for Viruses and DNA Traces Instead of Extant Bacteria Traces

Ksanfomality, L. V., Institute of Space Research, USSR; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 26; In English; See also 19990020835; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

A current program of investigations of organic components in ALH 84001 meteorite findings includes a study of the polycyclic aromatic hydrocarbons traces, C-isotopic analysis, a search for amino-acid traces, O-isotopic analysis, etc. All of these studies are based on a hypothesis about a presence of martian prehistoric primitive life traces in the SNC meteorite from Mars. The hypothesis is based on the contemporary existing notions of the origin of life that originated in natural fashion, through numberless chemical reactions, which were highly probable under the conditions of young Earth. There are a number of proofs that these same conditions occurred early in martian history, which means life could have originated on Mars as well. The only known terrestrial life form is amino-nucleic-acid life that uses nucleic acids as an information system. Primitive life forms include both microbes and viruses. It is known that viruses are able to withstand much more severe conditions than bacteria. Their inactive forms may survive for a long time until favorable conditions occur again. Thus, it could make sense to look for viruses or even DNA traces both in the body of the ALH84001 meteorite and on Mars in future space missions.

Author

*Amino Acids, Deoxyribonucleic Acid, Mars (Planet), SNC Meteorites, Viruses, Extraterrestrial Life, Exobiology, Planetary Environments*

19990020862: Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Principal Component Analysis for Biosignature Detection in Extraterrestrial Samples

McDonald, G. D., Jet Propulsion Lab., California Inst. of Tech., USA; Storrie-Lombardi, M. C., Jet Propulsion Lab., California Inst. of Tech., USA; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 30-31; In English; See also 19990020835; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

Analysis of extraterrestrial samples for organic signatures of past or present life presents several problems. Chief among these is distinguishing bona fide extraterrestrial organic material from terrestrial contamination, either carried on a spacecraft or present in the terrestrial environment to which the sample is exposed. A related problem is separating biologically derived molecules from those produced by abiotic syntheses in the interstellar medium, on meteorite parent bodies, or in planetary atmospheres and oceans.

Author

*Meteorites, Organic Materials, Principal Components Analysis, Signatures, SNC Meteorites, Extraterrestrial Life, Evolution*

19990020867 Stanford Univ., Dept. of Geological and Environmental Sciences, Stanford, CA USA

Recognizing Life and its Evolution Through Biomarkers

Moldowan, J. M., Stanford Univ., USA, Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 37-38, In English, See also 19990020835, No Copyright, Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only, Abstract Only

Biomarkers are molecular fossils found in sedimentary rocks and petroleum. Like fossils, they are recognized as remnants of enzyme-mediated biosynthesis dictated by genetic code. They cannot be confused with abiogenic molecules, because they are produced in abundances that far exceed their relative chemical stabilities.

Author

*Biosynthesis, Fossils, Paleobiology, Microorganisms*

19990020868 NASA Johnson Space Center, Houston, TX USA

Possible Microfossils (Warrawoona Group, Towers Formation, Australia, approximately 3.8-3.6 Ga)

Morris, P. A., Houston Univ., USA; Wentworth, S. J., Lockheed Martin Corp., USA; Allen, C. C., Lockheed Martin Corp., USA; McKay, D. S., NASA Johnson Space Center, USA, Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 38-39, In English, See also 19990020835  
Contract(s)/Grant(s): NAG9-980, NAG9-367, No Copyright, Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only, Abstract Only

Early in the twentieth century there were reports of Archean stromatolite-like structures that were similar to organic rich stromatolites from the base of the Cambrian (600 m.y.). It was not until the latter half of this century that fossilized Archean-age (3.9-2.5 Ga) life forms were found in the Fig Tree Formation of South Africa and the Towers Formation of Australia. Some of the ancient stromatolites contained streaks and clots of kerogen, pyrite grains, remnants of microbial cells, and filaments that represented various stages of preservation, while others appeared to lack fossils. A set of physical criteria was established for evaluating the biogenicity of these Archean discoveries: (1) rocks of unquestionable Archean age; (2) microfossils indigenous to Archean sediments; and (3) microfossils occurring in clasts that are syngenetic with deposition of the sedimentary unit. In the case of bedded cherts, the fossils should predate the cherts; (4) the microfossils are biogenic; and (5) replicate sampling of the fossiliferous outcrop firmly demonstrates the provenance of these microfossils. Sample 002 from the Precambrian Paleobiology Research Group (PPRG) was examined. This stromatolitic carbonaceous chert contains microbial remains that meet the established criteria [10]. Using a scanning electron microscope (SEM), we have analyzed the morphologies and chemistry of these possible microbial remains.

Author

*Microorganisms, Paleobiology, Precambrian Period, Rocks*

19990020871 Lockheed Martin Corp., Houston, TX USA

Reconnaissance Sampling of Airborne Molecular Organic Contamination in the Meteorite Curation Facility of Johnson Space Center

Schilling, E. A., Lockheed Martin Corp., USA; Schneider, M. N., Lockheed Martin Corp., USA, Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 40-42, In English, See also 19990020835, No Copyright, Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only, Abstract Only

Determining the extent of contamination of meteorites by terrestrial organic compounds has become a question of critical importance in the last several years. Contamination issues have been considered in the past and recognized as important, resulting in a good deal of study. However, more thoroughly understanding organic contamination issues is especially pressing – in considering possible evidence of previous life on Mars and in future Mars sample-return missions.

Author

*Contamination, Extraterrestrial Life, Mars (Planet), Mars Sample Return Missions, Meteorites, Organic Compounds, Paleobiology, SNC Meteorites*

199900200079 NASA Johnson Space Center, Houston, TX USA

Mineralization of Bacteria in Terrestrial Basaltic Rocks: Comparison With Possible Biogenic Features in Martian Meteorite Allan Hills 84001

Thomas-Keprta, K. L., Lockheed Martin Corp., USA; McKay, D. S., NASA Johnson Space Center, USA; Wentworth, S. J., Lockheed Martin Corp., USA; Stevens, T. O., Battelle Pacific Northwest Lab., USA; Tanton, A. E., Arkansas Univ., USA; Allen, C. C., Lockheed Martin Corp., USA; Gibson, E. K., Jr., NASA Johnson Space Center, USA; Romanek, C. S., Savannah River Ecology Lab., USA; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 53-54; In English; See also 19990020035; No Copyright; Avail. CASI: A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The identification of biogenic features altered by diagenesis or mineralization is important in determining whether specific features in terrestrial rocks and in meteorites may have a biogenic origin. Unfortunately, few studies have addressed the formation of biogenic features in igneous rocks, which may be important to these phenomena, including the controversy over possible biogenic features in basaltic martian meteorite ALH84001. To explore the presence of biogenic features in igneous rocks, we examined microcosms growing in basaltic small-scale experimental growth chambers or microcosms. Microbial communities were harvested from aquifers of the Columbia River Basalt (CRB) group and grown in a microcosm containing uncultured basalt chips and groundwater (technique described in). These microcosms simulated natural growth conditions in the deep subsurface of the CRB, which should be a good terrestrial analog for any putative martian subsurface ecosystem that may have once included ALH84001. Here we present new size measurements and photomicrographs, comparing the putative martian fossils to biogenic material in the CRB microcosms. The range of size and shapes of the biogenic features on the CRB microcosm chips overlaps with and is similar to those on ALH84001 chips. Although this present work does not provide evidence for the biogenicity of ALH84001 features, we believe that, based on criteria of size, shape, and general morphology, a biogenic interpretation for the ALH84001 features remains plausible.

Author

*Bacteria; Basalt; Fossils; Geochemistry; Igneous Rocks; Mars (Planets); Microorganisms; Sediments; SNC Meteorites*

199900200080 Lunar and Planetary Inst., Houston, TX USA

Ancient Martian Life in Allan Hills 84001? Status of Some Current Controversies

Treiman, A. H., Lunar and Planetary Inst., USA; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 54-56; In English; See also 19990020035; No Copyright; Avail. CASI: A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

Four lines of evidence were taken to suggest that ALH84001 contained traces of ancient martian life preserved in its carbonate mineral masses: [1] abundance of organic compounds Polycyclic aromatic hydrocarbons (PAHs), [2] disequilibrium mineral assemblages, [3] morphology of submicrometer magnetite crystals, and [4] presence of objects comparable in size and slope to bacteria. This evidence is predicated on the carbonate globules having formed at temperatures conducive to life. Here, I review evidence on carbonate formation temperature, martian origin of organic compounds, and bacteria-shaped objects.

Author

*Mars (Planets); Mineral Deposits; Evolution; Extraterrestrial Life; Polycyclic Aromatic Hydrocarbons; Carbonates; Temperature; Magnetite; Bacteria*

199900200085 NASA Johnson Space Center, Houston, TX USA

Terrestrial Biomarkers for Early Life on Earth as Analogs for Possible Martian Life Forms: Examples of Mineralized Replaced Bacteria and Biofilms From the 3.5-3.3-Ga Barberton Greenstone Belt, South Africa

Westall, J., NASA Johnson Space Center, USA; McKay, D. S., NASA Johnson Space Center, USA; Gibson, E. K., NASA Johnson Space Center, USA; deWit, M. J., Cape Town Univ., South Africa; Dunn, J., Cape Town Univ., South Africa; Germeke, D., Cape Town Univ., South Africa; deRonde, C. E. J., Institute of Geological and Nuclear Sciences Ltd., New Zealand; Workshop on the Issue Martian Meteorites: Where do we Stand and Where are we Going?, 1998, pp. 61-62; In English; See also 19990020035; No Copyright; Avail. CASI: A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

The search for extraterrestrial life and especially martian life hinges on a variety of methods used to identify vestiges of what we could recognize as life, including chemical signatures, morphological fossils, and biogenic precipitates. Although the possibility of extant life on Mars (subsurface) is being considered, most exploration efforts may be directed toward the search for fossil life. Geomorphological evidence points to a warmer and wetter Mars early on in its history, a scenario that encourages comparison with the early Earth. For this reason, study of the early terrestrial life forms and environment in which they lived may provide clues as to how to search for extinct martian life. As a contribution to the early Archean database of terrestrial microfossils, we present new data on morphological fossils from the 3.5-3.3-Ga Barberton greenstone belt (BGB), South Africa. This study under-

lives the variety of fossil types already present in some of the oldest, best-preserved terrestrial sediments, ranging from mineral-replaced bacteria and bacteria molds of various morphologies (coccioid, coccobacillus, bacillus) to mineral-replaced biofilm. Biofilm or extracellular polymeric substance (EPS) is produced by bacteria and appears to be more readily fossilizable than bacteria themselves. The BGII fossils occur in shallow water to subaerial sediments interbedded with volcanic lavas, the whole being deposited on oceanic crust. Penecontemporaneous silicification of sediments and volcanics resulted in the chertification of the rocks, which were later subjected to low-grade metamorphism (lower greenschist).

**Author**

*Bacteria; Extraterrestrial Life; Fossils; Lava; Structural Properties (Micrology); Biogeochemistry; Colonies; Morphology*

19990021036 San Diego Univ., Biology Dept., San Diego, CA USA

Investigations of the Effects of Altered Vestibular System Function on Hindlimb Anti-Gravity Muscles

Lowery, Mary Sue, San Diego Univ., USA, Oct. 1998, 3p, In English, See also 19990021025, No Copyright, Avail: CASI: A01, Hardcopy, A02, Microfiche

Exposure to different gravitational environments, both the microgravity of spaceflight and the hypergravity of centrifugation, result in altered vestibulo-spinal function which can be reversed by reacclimation to earth gravity (2). Control of orientation, posture, and locomotion are functions of the vestibular system which are altered by changes in gravitational environment. Not only is the vestibular system involved with coordination and proprioception, but the gravity sensing portion of the vestibular system also plays a major role in maintaining muscle tone through projections to spinal cord motoneurons that control anti-gravity muscles. I have been involved with investigations of several aspects of the link between vestibular inputs and muscle morphology and function during my work with Dr. Nancy Daunton this summer and the previous summer. We have prepared a manuscript for submission (4) to Aviation, Space, and Environmental Medicine based on work that I performed last summer in Dr. Daunton's lab. Techniques developed for that project will be utilized in subsequent experiments begun in the summer of 1998. I have been involved with the development of a pilot project to test the effects of vestibular galvanic stimulation (VGS) on anti-gravity muscles and in another project testing the effects of the ototoxic drug streptomycin on the otolith-spinal reflex and anti-gravity muscle morphology.

**Author**

*Research; Vertigo; Gravitation; Manual Therapy; Muscular Function; Aerospace Medicine; Detection*

19990021037 Washington Univ., School of Fisheries, Seattle, WA USA

Ecological Support of Larval Fish During Multigenerational Studies on Space Station

Taub, Frieda B., Washington Univ., USA, Oct. 1998, 3p, In English, See also 19990021025, No Copyright, Avail: CASI: A01, Hardcopy, A02, Microfiche

Live, microscopic food is required by larval Zebrafish, *Danio rerio*, which are candidates for the Aquatic Habitat of the Space Station Biological Research Project (SSBRP). Zebrafish have proven to be convenient research animals, and their embryology and genetics are extensively documented. Their ability to mature at 3 months of age, and the transparent eggs which hatch in 2 days, are attractive attributes for space research. Among the goals of the SSBRP Aquatic Habitat is the ability to study three generations, with the objective of maintaining adults, their offspring, and the maintaining of these offspring through maturity and spawning. For Zebrafish, it is anticipated that sexually mature fish (P1) would be delivered to Space Station and spawned in space. The challenge would be it to provide appropriate microscopic foods for the offspring (F1), and 3 months later for the next generation (F2); if these were raised to maturity and bred, live foods would be required at approximately 6 months. In laboratories where Zebrafish are traditionally reared, the larval foods are the protozoan *Paramecium micromultimiculeatum* and later brine shrimp *Artemia nauplii*. Under normal laboratory conditions, the rearing of these foods are relatively easy, although time consuming because of the food organisms must be separated from their rearing medium which is discarded. A freshwater food chain that would ensure healthy on-orbit research animals is needed. The food chain should (a) be reared in conditions that are compatible with the larval fish (water chemistry, pH, temperature and light), (b) assist in maintaining water quality (by removing ammonia, nitrate, phosphate, carbon dioxide, and bacteria) and (c) be convenient for the space crew (minimize handling and waste production).

Derived from text

*Ecology; Fishes; Embryology; Spacelborne Experiments; Artemia; Food Chain; Fresh Water; Organisms*

## AEROSPACE MEDICINE

*Includes: physiological factors; biological effects of radiation; and, effects of weightlessness on man and animals.*

1000019206 Princeton Univ., Dept. of Ecology and Evolutionary Biology, NJ USA

From Individuals to Epidemics

n/Levin, Simon A., Princeton Univ., USA; Durrett, R., Cornell Univ., USA; Phil. Trans R. Soc. Lond. B; 1996, Volume 351, pp. 1615-1621, In English

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Heterogeneous mixing fundamentally changes the dynamics of infectious diseases. Finding ways to incorporate it into models represents a critical challenge. Phenomenological approaches are deficient in their lack of attention to underlying processes; individual-based models, on the other hand, may obscure the essential interactions in a sea of detail. The challenge then is to find ways to bridge these levels of description, starting from individual-based models, and deriving macroscopic descriptions from them that retain essential detail, and filter out the rest. In this paper, attempts to achieve this transformation are described for a class of models where non-random mixing arises from the spatial localization of interactions. In general, the epidemic threshold is found to be larger owing to spatial localization than for a homogeneous mixing population. An improved estimate of the dynamics is developed by the use of moment equations, and a simple estimate of the threshold in terms of a 'dyad heuristic'. For more general models in which local infection is not described by mass action, the connection with related partial differential equations is investigated.

Author

*Infectious Diseases; Heterogeneity; Heuristic; Methods; Phenomenology*

1000019377 NASA Langley Research Center, Hampton, VA USA

Aerospace Medicine and Biology: A Continuing Bibliography with Indexes, Supplement 485

Feb. 22, 1999, 23p, In English

Report No(s): NASA/SP-1999-7011/SUPPL485; NAS 1.21:7011/SUPPL485; No Copyright, Avail: CASI, A03, Hardcopy, A01, Microfiche

This supplemental issue of Aerospace Medicine and Biology, A Continuing Bibliography with Indexes (NASA/SP-1999-7011) lists reports, articles, and other documents recently announced in the NASA STI Database. In its subject coverage, Aerospace Medicine and Biology concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion. Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The NASA CASI price code table, addresses of organizations, and document availability information are included before the abstract section. Two indexes—subject and author are included after the abstract section.

CASI

*Aerospace Medicine; Bibliographies; Biostatistics; Biological Effect; Exobiology; Indexes (Documentation)*

1000019756 Johns Hopkins Univ., Baltimore, MD USA

Structural Indices of Stress Fracture Susceptibility in Female Military Recruits. Final Report, 22 Sep 1995 - 21 Sep 1998

Beck, Thomas J., Oct. 1998, 32p, In English

Report No(s): AD-A356178; No Copyright, Avail: CASI, A03, Hardcopy, A01, Microfiche

Six hundred-ninety three female U.S. Marine Corps recruits were studied with anthropometry and dual energy x-ray absorptiometry (DXA) scans of the thigh and lower leg prior to recruit training. A total of 37 stress fractures were confirmed. Female data were combined with an earlier study of 626 male Marine recruits including 38 stress fracture cases. Bone structural geometry, cortical dimensions, thigh lean mass and muscle cross-sectional area were derived from DXA data. Measurements were compared within sex between pooled fracture cases and controls. Fracture cases in both sexes were less physically fit, and had smaller thigh muscles compared to controls. After correction for body size, section moduli ( $Z$ ) and bone strength indices of the femur and tibia were smaller in fracture cases of both sexes but patterns differed. Compared to controls, female cases had thinner cortices and lower BMD. Male cases had narrower bones but similar cortical thickness and BMD. In both sexes, differences suggest poor skeletal adaptation to training in fracture cases due to inadequate prior conditioning. Lower stress fracture rates in African Americans

compared to whites or Hispanics suggest stronger bones. Ethnic differences in bone and muscle indices of fracture susceptibility were studied within sex, using pooled data compared among ethnic groups. African Americans of both sexes showed longer leg bones, narrower pelvis, larger tibia Z's, leaner thighs and larger thigh muscles than other groups, although initial fitness levels were similar (males) or worse (female's). Differences suggest genetically stronger skeletal mechanics in African Americans, compared to other groups. Results imply that stress fracture susceptibility and bone strength have both environmentally plastic and genetic components.

DTIC

*Physical Fitness; Musculoskeletal System; X-Ray Analysis; Anthropometry; Females; Ethnic Factors*

19990021027 Arkansas Univ. for Medical Sciences, Dept. of Biopharmaceutical Sciences, Little Rock, AR USA

Virtual Reality Simulation of the Effects of Microgravity in Gastrointestinal Physiology

Compadre, Cesar M., Arkansas Univ. for Medical Sciences, USA; Oct. 1998; 4p; In English; See also 19990021025; No Copyright; Avail: CASI, A01, Hardcopy, A02, Microfiche

The ultimate goal of this research is to create an anatomically accurate three-dimensional (3D) simulation model of the effects of microgravity in gastrointestinal physiology and to explore the role that such changes may have in the pharmacokinetics of drugs given to the space crews for prevention or therapy. To accomplish this goal the specific aims of this research are: 1) To generate a complete 3-D reconstructions of the human Gastrointestinal (GI) tract of the male and female Visible Humans. 2) to develop and implement time-dependent computer algorithms to simulate the GI motility using the above 3-D reconstruction.

Author

*Virtual Reality; Simulation; Microgravity; Gastrointestinal System; Three Dimensional Models*

19990021037 Bowling Green State Univ., School of HEP - Kinesiology, OH USA

High Salt Diets, Bone Strength and Mineral Content of Mature Femur After Skeletal Unloading

Liang, Michael T. C., Bowling Green State Univ., USA; Oct. 1998; 3p; In English; See also 19990021025; No Copyright; Avail: CASI, A01, Hardcopy, A02, Microfiche

It is known that high salt diets increase urinary calcium (Ca) loss, but it is not known whether this effect weakens bone during space flight. The Bone Hormone Lab has studied the effect of high salt diets on Ca balance and whole body Ca in a space flight model (2,3). Neither the strength nor mineral content of the femurs from these studies has been evaluated. The purpose of this study was to determine the effect of high salt diets (HiNa) and skeletal unloading on femoral bone strength and bone mineral content (BMC) in mature rats.

Author

*Bone Mineral Content; Calcium; Minerals; Diets*

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### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

*Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space transportation*

19990019114 Civil Aeromedical Inst., Oklahoma City, OK USA

Performance of a Portable Oxygen Breathing System at 25,000 Feet Altitude

Gartner, Robert P., Civil Aeromedical Inst., USA; Murphy, Richard E., Civil Aeromedical Inst., USA; Hudgins, Chad B., Civil Aeromedical Inst., USA; Mandella, Joseph G., Jr., Civil Aeromedical Inst., USA; Nov. 1998; 11p; In English; Report No.(s): AD-A357729; DOT/FAA/AM-98/27; No Copyright; Avail: CASI, A03, Hardcopy, A01, Microfiche

A portable oxygen system utilizing open port dilution rebreathing mask technology was tested for its ability to deliver an adequate supply of oxygen at an altitude of 25,000 feet above sea level. Twenty-two subjects, 11 females and 11 males, participated in the study. Blood oxygen saturation (SaO<sub>2</sub>) baseline levels for hypoxic exposure were established for each subject. Altitude testing consisted of the subject being placed in a hypobaric chamber and it being decompressed to an altitude of 25,000 feet. Immediately after the start of the decompression, the subject was instructed to don the oxygen mask and start the flow of oxygen from the portable cylinder. Oxygen flow to the mask was continuous at 4 liters per minute. Once at altitude, the subjects pedaled a cycle ergometer at a resistance of 15 watts for five minutes. SaO<sub>2</sub> and other physiological variables were monitored throughout the altitude exposure. SaO<sub>2</sub> levels were maintained at ground level values for all subjects throughout the altitude exposures. At no point

during the testing did oxygenation levels approach baseline levels for hypoxic exposure. The portable oxygen system tested provided protection from hypobaric hypoxia at an altitude of 25,000 feet.

DTIC

*Oxygen Breathing, Oxygen Masks, Altitude, Portable Life Support Systems*

19990019179 Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

A Reliability Model of a Man-Machine System with Human Errors and its Applications

Liu, Chih-Ming, National Tsing Hua Univ., Taiwan, Province of China; Wang, An-Hsiang, Oriental Inst. of Tech., Taiwan, Province of China; Journal of the Chinese Institute of Engineers, Mar. 1998; ISSN 0253-3839; Volume 21, No. 2, pp. 149-158. In English. No Copyright. Avail: Issuing Activity. Hardcopy. Microfiche

A continuous-time Markov chain model, which considers the concept of human errors and recovery factors, is proposed for analyzing the reliability of a man-machine system. The model can be applied to general systems which involve man-machine interactions. Both the reliability and the mean time between breakdowns of a system can be predicted by using this model. An inspection system, a conveyor line system, a cellular manufacturing system, and an automatic assembly machine are used to demonstrate the application of the reliability model. During the design stage of a man-machine system, the model can provide reliability evaluation information to aid in the choice of different alternatives for man-machine interaction. During the operating stage of a system, the model can also provide reliability information to improve system reliability.

Author

*Human Factors Engineering, Man-Machine Systems, Reliability Analysis, Errors*

19990019563 NASA Marshall Space Flight Center, Huntsville, AL, USA

Comparison of Human Modeling Tools for Efficiency of Prediction of EVA Tasks

Dischinger, H. Charles, Jr., NASA Marshall Space Flight Center, USA; Loughead, Tomas E., NASA Marshall Space Flight Center, USA; 1998; 1p. In English. NASA University Research Centers Technical Conference 1998, 22-26 Feb. 1998, Huntsville, AL, USA. No Copyright. Avail: Issuing Activity. Abstract Only. Hardcopy. Microfiche

Design of ExtraVehicular Activity (EVA) interfaces for International Space Station is important to successful assembly. This is highlighted by the recent rise in the estimate of time required for EVA during the assembly to 900 hours. The traditional method of evaluating EVA design is examination of mockups in neutral buoyancy testing. While effective, this is costly. Any tools for streamlining this process have positive cost and schedule implications for Station design. The human modelling software package Jack has been shown to be a useful tool in computer-aided design of space hardware requiring actuation in EVA. The package has been used to aid in the design of flight hardware for a Station Assembly Mission; evaluation was based on comparison of the computer simulations with neutral buoyancy simulations. When used to predict the feasibility of tasks, the software was found to be effective for reach and visibility evaluation. Some limitations have been encountered in prediction of work clearances. Another human simulator is currently being evaluated using the same hardware and comparisons to the same Neutral Buoyancy simulations. Preliminary results for ERGO, which is derived from robotics software, indicate similar strengths and weaknesses.

Author

*Applications Programs (Computers), Buoyancy, Computerized Simulation, Extravehicular Activity*

19990021031 Alaska Univ., Dept. of Aviation Technology, Anchorage, AK USA

F18 Life Support: APECS and EDOX Cockpit Integration

Herrick, Paul, Alaska Univ., USA; Oct. 1998; 3p. In English. See also 19990021025; No Copyright. Avail: CASI; A01, Hardcopy; A02, Microfiche

Two systems are currently being integrated into the F18 Hornet support aircraft at NASA Dryden Flight Research Center (DFRC). The first system is the Aircrew Personal Environmental Control System (APECS). The system is designed to increase aircrew performance by combating heat stress in the cockpit. The second system is the Extended Duration Oxygen System (EDOX). This system will provide additional redundancy and oxygen system duration to the F18 without extensive modification to the current system.

Author

*Life Support Systems, F-18 Aircraft, Environmental Control*

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